60001877

Mining District File Summary Sheet

DISTRICT	Rosebud
DIST_NO	4010
COUNTY If different from written on document	Pershing
TITLE If not obvious	Rosebud Mineable Reserve Estimation Procedures
AUTHOR	Gray D; Clayton R; Muerhoff, C; Roberts L; Tschander, R; Allen L
DATE OF DOC(S)	1994
MULTI_DIST Y / N? Additional Dist_Nos:	
QUAD_NAME	Sulphur 7½'
P_M_C_NAME (mine, claim & company names)	Rosebud Mine; Hecla Mining Co
COMMODITY If not obvious	gold, silver
NOTES	Correspondence about reserve estimation; handwritten notes 15 p

Keep docs at about 250 pages if no oversized maps attached (for every 1 oversized page (>11x17) with text reduce the amount of pages by ~25)

SS: DP 8/1/08
Initials Date

DB:
Initials Date

SCANNED:
Initials Date

Revised: 1/22/08

MINABLE RESERVE ESTIMATION PROCEDURES
(D. GRAY, MAY 1994)

60001877 4010

60001877 CM 4016

MEMO TO: Don Gray

FROM: Ron Clayton

DATE: 05/25/94

SUBJECT: Ore Reserve and Estimation Policy and Terminology

As you well know, there has been significant recent discussion regarding terminology used in describing a mineral occurrence and the inadequacy of our current corporate policy regarding this issue. Rick Tschauder has been assigned the task of rewriting the corporate policy. However, I don't expect the revision to be approved and available for our use during the current phase of the Rosebud project. We have an opportunity to be a part of this revision by making Rick aware of our opinions throughout the process.

Rick has forwarded the attached paper and indicated that his current direction for the new policy is along the lines advocated in the paper. He has suggested and I concur that this guideline should be adopted by the Rosebud Project until a new policy is approved. I believe that the terminology can be incorporated into the procedure you recently outlined. (5/23/94 Memo **"MINABLE RESERVE ESTIMATION")**. I would like your opinion as well as that of Charlie and Lauren.

Applied to the current status of the Rosebud project, I would interpret the paper as follows:

The entire 712,000 ounces in Larry Allen's estimate is currently in the Indicated Resource category.

The Far East Zone is currently an Inferred Resource.

Once the current South Zone project is complete and Charlie is able to interpret the geology and grade continuity with more confidence and the edges of the ore zone are better defined, I would expect us to be able to calculate a Measured Resource for this area.

Assuming we go forward with a twenty hole surface drilling program for the North, East, and Far East Zones. The results of that program must dictate whether or not these areas can be upgraded to the Measured Resource category or remain Indicated Resources.

Only after an engineered cut-off is calculated, a mine plan is engineered, a feasibility study is completed, and we are confident that any legal and permitting issues are or with high confidence can be resolved would the Resource be upgraded to a Reserve.

I believe that the procedure outlined in your May 23,1994 Memo continues to be appropriate with the following modifications:

Change "IN-SITU GEOLOGIC RESOURCE" to **RESOURCE**

Change "IN-SITU MINEABLE RESOURCE/RESERVE" to **RESOURCE TO RESERVE**

Change "MINEABLE RESOURCE/RESERVE" to **RESERVE**

"SCHEDULED PRODUCTION" then becomes part of the process of upgrading a resource to a reserve.

Please comment so that we can finalize our terminology for the Rosebud project in a timely manner.

cc: C. Muerhoff
L. Roberts
R. Tschauder

HECLA MINING COMPANY

May 24, 1994

MEMORANDUM TO: Ron

FROM: Rick Rick

SUBJECT: **Ore Reserve Definitions**

Until I rewrite corporate policy to make it official, I strongly recommend you support using the terms contained in this document for reporting exploration information, resources, and reserves.

A Guide for Reporting Exploration Information, Resources and Reserves
in Mining Engineering; April 1991, p 379-384

Post-It™ brand fax transmittal memo 7671 | # of pages ▸ 2

To GM/LR	From Don Gray
Dept.	Phone #
Fax #	Fax #

Hecla
MINING COMPANY

May 23, 1994

MEMORANDUM TO: Ron Clayton

FROM: Don Gray DG

SUBJECT: **Mineable Reserve Estimation Procedures**

Following our discussion on ore reserve estimation, I had several ideas on procedures we may use. Some of these ideas may be more applicable to definition of ore on new projects, but I think the general principles would be applicable to on-going operations.

Several levels of estimation should be applied before a resource is classified as mineable reserve.

- **In-Situ Geologic Resource**. This estimate is completed by the geologist. Regardless of whether the model is manually or computer generated, the most critical factor is that a good geologic understanding is incorporated. Geologic parameters such as structure (faulting, jointing, bedding), lithology, and mineralogy/chemistry must be well defined because these items will establish the boundary conditions. Other factors such as drill hole spacing or sampling intervals will also largely effect how precisely a deposit can be modelled. Although geostatistical packages are capable of generating block sizes as small as desired, lack of data (for example, due to wide drill hole spacing) could result in a model with less accuracy than the block size implies.

- **In-Situ Mineable Resource/Reserve**. Once the geologist completes the in-situ geologic resource/reserve estimate, the mining engineer can assess the applicable mining method, development access, and cut-off grade to determine which areas can be mined (preliminary evaluation of mining method would occur prior to the geologic estimate, although the process might be iterative). Ore body geometry and the spatial relationship among zones would be used to assess which portions of the in-situ geologic estimates are mineable. Geologic plans and sections along with rock mechanics information can be used to estimate the grade factor (related to dilution) and extraction factor (related to rock strength and mining method); these factors may vary for different parts of the deposit.

- **Scheduled Production**. The in-situ mineable resource/reserve can be divided into stoping blocks which would be scheduled over the mine life. Extraction and grade factors can be applied to provide a realistic estimate of the tonnage and grade which would actually be produced from a stope. A margin analysis would be used to maximize margin for the scheduled production. The scheduled production may not equal the in-situ mineable tonnage due to the application of extraction/grade factors and the fact some tonnage may be left in a stope because the overall production rate at the end of mine life may be too low or ground conditions may be too poor to completely mine the deposit (recovery of the deposit may be less than 100%).

- **Mineable Resource/Reserve.** In the case of a new deposit, a full economic analysis is required to determine the profitability of the schedule production. Costs which must be included are as follows:

  - Capital Expenditures (mill, mining equipment, facilities)
  - Pre-Production Development
  - Mining Fixed and Variable Costs (including sustaining development)
  - Milling Fixed and Variable Costs
  - General Plant Costs

  Once a study establishes the resource can be mined at a profit, the scheduled production (tonnage and grade) can be classified as mineable resource/reserve. If there is a high confidence in the existing data and the associated risks are acceptable, the resource can be classified as a mineable reserve.

At each of the three major estimation steps (in-situ geologic, in-situ mineable, and mineable), the confidence level could be indicated by classifications of resource or reserve (or other terms such as drill-indicated or proven and probable might apply). Metal and tonnage recovery for the in-situ mineable and mineable resource/reserve can be calculated as a percentage of the in-situ geologic estimate to indicate mining efficiency.

DG/vm
cc:
C. Muerhoff
L. Roberts
R. Tschauder

Hecla
MINING COMPANY

May 23, 1994

MEMORANDUM TO: Ron Clayton

FROM: Don Gray DG

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- Resource to Reserve
  ~~In-Situ Mineable~~ Resource/Reserve. Once the geologist completes the in-situ geologic resource/reserve estimate, the mining engineer can assess the applicable mining method, development access, and cut-off grade to determine which areas can be mined (preliminary evaluation of mining method would occur prior to the geologic estimate, although the process might be iterative). Ore body geometry and the spatial relationship among zones would be used to assess which portions of the in-situ geologic estimates are mineable. Geologic plans and sections along with rock mechanics information can be used to estimate the grade factor (related to dilution) and extraction factor (related to rock strength and mining method); these factors may vary for different parts of the deposit.

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DG/vm
cc:
C. Muerhoff
L. Roberts
R. Tschauder

Hecla
MINING COMPANY
Centennial
1891 - 1991

Technical Services

Fax: (208) 769-4122

Date: 5/25

To: Lauren & Charlie

From: Don

Hecla Mining Company

Transmitting: 10 Pages
(Including Cover)

Operator:

Original in mail.

LR/CM:

Ron wants to discuss this some time. Rick will be establishing a new reserve policy/guidelines, and Ron thought we will want to complete Rosebud work in-line with what Rick will propose.

Some of the terms in my description were more procedural and would not be published numbers; they are more steps along the way.

Give it some thought.

Regards,

Don.

6500 Mineral Drive • Box C-8000 • Coeur d'Alene, Idaho 83814-1931 • 208/769-4100 • FAX 208/769-4107

MEMO TO: Don Gray

FROM: Ron Clayton

DATE: 05/25/94

SUBJECT: Ore Reserve and Estimation Policy and Terminology

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L. Roberts
R. Tschauder

HECLA MINING COMPANY

May 24, 1994

MEMORANDUM TO: Ron

FROM: Rick

SUBJECT: Ore Reserve Definitions

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CM

Hecla
MINING COMPANY

May 23, 1994

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FROM: Don Gray DG

SUBJECT: **Mineable Reserve Estimation Procedures**

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At each of the three major estimation steps (in-situ geologic, in-situ mineable, and mineable), the confidence level could be indicated by classifications of resource or reserve (or other terms such as drill-indicated or proven and probable might apply). Metal and tonnage recovery for the in-situ mineable and mineable resource/reserve can be calculated as a percentage of the in-situ geologic estimate to indicate mining efficiency.

DG/vm
cc:
C. Muerhoff
L. Roberts
R. Tschauder

Hecla
MINING COMPANY

DRAFT

May 20, 1994

MEMORANDUM TO: Ron Clayton

FROM: Don Gray

SUBJECT: ~~1994 Year-End Reserve Estimate for Rosebud~~ Mineable Reserve Estimation Procedures

Following our discussion on ore reserve estimation, I had several ~~more~~ ideas ~~which should be outlined.~~ on procedures we may use. Some of these ideas may be more applicable to definition of ore on new projects, but I think the general principles would be applicable to on-going operations.

Several levels of estimation should be applied before a resource is classified as mineable ore.

- In-Situ Geologic Resource. (Bold) This estimate is completed by the geologist. Regardless of whether the model is manually or computer generated, the most critical factor is that a good geologic understanding is incorporated. Geologic parameters such as structure (faulting, jointing, bedding), lithology, and mineralogy/chemistry must be well defined because these items will ~~define~~ establish the boundary conditions. Other factors such as drilling hole spacing or sampling intervals will also largely effect how precisely a deposit can be modelled. Although ~~geostastical~~ geostatistical packages are capable of generating block sizes as small as desired, lack of data (for example, due to wide drill hole spacing) could result in ~~a meaningless~~ less precise model.

- In-Situ Mineable Resource/Reserve. (Bold) Once the geologist completes the in-situ geologic resource/reserve estimate, the mining engineer can assess the applicable mining method,

development access, and cut-off grade to determine which ~~"blocks"~~ areas can be mined (preliminary ~~evolution~~ evaluation of mining method would occur prior to the geologic estimate, although the process might be iterative). Ore body geometry and the spatial relationship among zones would be used to assess which portions of the in-situ geologic estimate are mineable. Geologic plans and sections along with rock mechanics information can be used to estimate the grade factor (related to dilution) and extraction factor (related to rock strength and mining method); these factors may ~~be different~~ vary for different parts of the deposit.

- Scheduled Production. The in-situ mineable resource/reserve can be divided into stoping ~~works~~ blocks which would be scheduled over the life-of-mine. Extraction and grade factors can be applied to provide a realistic estimate of the tonnage and grade which would actually be produced from a stope. A margin analysis would be used to maximize margin for the scheduled production. The scheduled production may not equal the in-situ mineable tonnage due to the application of extraction/grade factors and the fact some tonnage may be left in a stope because the overall production rate would be too low to ~~operate the~~ completely mine the ~~mine~~ deposit (recovery of the deposit may be less than 100%).

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Once a study establishes the resource can be mined at a profit, the scheduled production (tonnage and grade) can be classified ~~a~~ as mineable reserve.

At each of the three major estimation steps (in-situ geologic, in-situ mineable, and mineable), the confidence level ~~can~~ could be indicated by ~~using the terms drill indicated, probable, and proven.~~ classifications of resource or reserve (or other terms such as drill-indicated ~~or~~ proven and probable might apply). Metal and tonnage recovery for the in-situ mineable and mineable resource/reserve can be calculated as a percentage of the in-situ geologic estimate to ~~help~~ indicate mining efficiency.

DG/vm

cc:
C. Muerhoff
L. Roberts
R. Tschauder